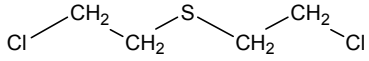
MUSTARD GAS
CAS No. 505-60-2
First Listed in the *First Annual Report on Carcinogens*



CARCINOGENICITY

Mustard gas is *known to be a human carcinogen* based on sufficient evidence of carcinogenicity in humans (IARC V.9, 1975; IARC S.4, 1982). Several studies have shown an increased mortality from respiratory tract cancer among individuals exposed to mustard gas. This mortality was greater in those individuals with long-term occupational exposure than in those with sporadic exposure.

An IARC Working Group reported that there is limited evidence of carcinogenicity of mustard gas in experimental animals (IARC V.9, 1975; IARC S.4, 1982). When administered by inhalation or intravenous injection, mustard gas caused increased incidences of lung tumors in mice of both sexes. Subcutaneous administration of mustard gas induced local fibrosarcomas or sarcomas in mice of both sexes.

PROPERTIES

Mustard gas [bis(2-chloroethyl) sulfide] is a colorless, oily liquid with a weak, sweet, agreeable odor. It is sparingly soluble in water and soluble in fat, fat solvents, and other common organic solvents. Mustard gas volatilizes in steam. It is combustible when exposed to heat or flame. When heated to decomposition, it emits very toxic fumes of sulfur oxides (SO_x), hydrochloric acid, and other chlorinated compounds.

USE

Mustard gas is used primarily as a model compound in biological studies of alkylating agents. Researchers have tested mustard gas as an antineoplastic agent, but its clinical use as a tumor inhibitor has been minimal. Use of mustard gas in chemical warfare occurred mainly during World War I (IARC V.9, 1975; HSDB, 1997). It was also formerly used in the topical treatment of psoriasis (HSDB, 1997).

PRODUCTION

There is no indication that mustard gas is manufactured or used in the United States at the present time (HSDB, 1997). U.S. companies produced and stockpiled the chemical during World War II, and stocks may have existed in the United States as recently as 1974; however, no volumes have been reported (IARC V.9, 1975). If production of mustard gas as a chemical warfare agent were to be resumed, it would probably be excluded from regulation under the National Security Clause contained in each regulatory authority.

EXPOSURE

The primary routes of potential human exposure to mustard gas are inhalation and dermal contact. From the 1987 Survey of Veterans conducted by the Census Bureau of Veterans Affairs, World War II (WWII) veterans had the highest percentage reporting health problems and disability (43%). The effects of mustard gas are of concern not only for this group but also WWI veterans. During the first war, as many as 28,000 of the American Expeditionary Forces were exposed to the chemical vesicant but seldom to lethal concentrations due to dispersion of the gas on the battlefield. Although mustard gas was not used in WWII, the United States produced and stockpiled the chemical for possible use. Aware of the same strategy occurring in other countries, particularly Germany and Japan, the U.S. military launched a secret research program to prepare against the threat of such an attack. Using military volunteers, top secret experiments of protective equipment, clothing, and antivesicant ointments were conducted. They involved patch or drop tests, chamber tests, and field tests. The patch or drop tests, employed to assess the strength of protective ointments, exposed anywhere from 15,000 to 60,000 soldiers and sailors to mustard gas. In chamber tests, protective masks and clothing were examined by exposing volunteers to the chemical in a gas chamber for an hour or more everyday or every other day until penetration was seen, evidenced by moderate to intense chemical burns on the skin. The same outcome was sought in field tests, which required soldiers to cross tropical or subtropical lands where the gas was dropped to check the quality of masks, protective clothing, and ointments. In the latter two experiments, at least 4000 servicemen were exposed to mustard gas. Occupational exposure was found to have also occurred during the manufacture of the gas during WWII (Bullman and Kang, 1994).

Although the greatest risk of exposure to date has been for military personnel, there is also some small risk for persons living near military installations that stockpile mustard gas. The average and maximum atmospheric concentrations likely to have been produced under military conditions have been estimated to be 3 and 5 ppm, respectively (IARC V.9, 1975).

Additional human exposure information may be found in the ATSDR Toxicological Profile for Mustard Gas (ATSDR, 1992-K023).

REGULATIONS

EPA regulates mustard gas under the Superfund Amendments and Reauthorization Act (SARA), subjecting it to reporting requirements. Emergency response plans are required under SARA if the threshold planning quantity of 500 lb is exceeded. EPA has not established a reportable quantity (RQ) for mustard gas under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), but does regulate it as a hazardous constituent of waste under the Resource Conservation and Recovery Act (RCRA). OSHA regulates mustard gas under the Hazard Communication Standard and as a chemical hazard in laboratories. Regulations are summarized in Volume II, Table A-30.